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Remarks on some agriolimacids from Spain (Gastropoda, Pulmonata: Agriolimacidae)

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New data on the anatomy and distribution of *Deroceras altimirai, D. ercinae,* and *D. rodnae* are hereby contributed. We propose to promote the taxon *D. altimirai levisarcobelum* to the specific level; *D. hilbrandi* is considered to be a junior synonym of *D. nitidum.*

Key words: Gastropoda, Pulmonata, Agriolimacidae, *Deroceras*, distribution, taxonomy, Spain, Iberian peninsula.

For a long period the study of the terrestrial molluscs of Spain has lagged behind that in other European countries. In order to correct this deficiency, the Spanish Ministry for Science and Education, through the Dirección General de Investigación Científica y Técnica (DGICYT), is at present funding several research programmes in the field of animal taxonomy. One of these is the so-called "Proyecto Fauna Ibérica I", which aims to determine the composition and distribution patterns of a number of traditionally neglected zoological groups. Information on the latter, together with that on other better-known taxa, will result in a thorough revision of the Iberian fauna. Slugs comprise a group (though not a natural one, as has been well established) of poorly known animals, and as such have been incorporated in that zoological research project.

Before systematic sampling throughout the Spanish regions, it was believed necessary to gain assurance on the taxonomic validity of the formerly described species by studying the type specimens. In addition to the examination of the types (if preserved), study of topotypes is also advantageous for obvious reasons.

From 1983 to 1987 topotypes of slugs were collected in Portugal, and in 1989 several localities in Spain from which dubious species had been recorded or described in the past, were visited. As a result, it can be stated that 33 taxa of uncertain status were found. New information concerning seven species of the genus *Deroceras* Rafinesque, 1820, is hereby supplied.

Specimen capturing, fixing, preservation and storage techniques used here are the ones customary among terrestrial malacologists. Samplings were made by day as well as by night and in situ photographs were taken of the slugs. The material under study belongs to the collection of the Department of Zoology of the University of Santiago de Compostela.

Except for the subgenus category, which we disregard in this context, the taxonomy adopted here is that of Wiktor (1989).

Deroceras nitidum (Morelet, 1845), figs. 1-8, 52

Synonym: *Deroceras hilbrandi* Altena, 1964.

Material examined: Barranco de las Víboras, UTM 30SVG60 (Sierra Nevada, Granada, Andalusia, type locality of *D. hilbrandi*), 20.11.89, 10 specimens; Puente de las

Herrerías, UTM 30SWO8 (Sierra de Cazorla, Jaén, Andalusia), 18.11.89, 25 specimens; Cerrado del Utrero, UTM 30SWG19 (Sierra de Cazorla), 19.11.89, 8 specimens; paratype of *D. hilbrandi* collected by C. O. van Regteren Altena, "north of La Maitena, Sierra Nevada, prov. of Granada, Spain (= about 3 km SE of Sierra de Guéjar; ca. 16 km ESE of Granada, c. 1500 m)", 10.04.60, deposited in the Nationaal Natuurhistorisch Museum of Leiden (The Netherlands).

Morelet (1845) described *Deroceras nitidum* from Serra de Caldeirão and Serra de Monchique (Portugal). Later it was studied by Simroth (1893) and Castillejo, Rodríguez & Outeiro (1989), who give an account of the Portuguese agriolimacids, including information on the morphology, copulation and geographical distribution of *D. nitidum*.

Altena's (1964) description of *D. hilbrandi* rests on two 25 mm long individuals collected by him in Sierra Nevada. Seen from above, the live slugs are reported to be bright black but, when preserved in alcohol, both specimens became dark grey, nearly black. Lateral areas of the sole are light-grey and the central one creamy. The penial gland is divided into four strongly lobate branches originating from a common point and, as the original description asserts, a short rectal caecum can be observed upon dissection.

Apart from its type locality in the Sierra Nevada, *D. hilbrandi* is also to be found in Sierra de Cazorla and from both sites individuals were collected for this study. Live slugs are bright black but turn to brown after immersion in 70% ethanol. Likewise, live specimens measuring up to 35 mm long shrink to 25 mm when treated in that manner. Body mucus is colourless. The ovotestis does not reach the rear end of the visceral mass (fig. 3). Penis divided into two parts (figs. 4-8). Proximal part of penis with a very conspicuous penial gland which consists of three or four profusely festooned branches. Near the entry of the vas deferens and the insertion of the penial retractor muscle there exists a lateral knob or penial caecum. The distal part of the penis shows a large bulbous sac, with seemingly glandulous walls, which contains the sarcobelum. This is a conical and pointed structure. In young individuals the penial gland is incompletely developed and the sarcobelum is small and weak, although it retains its species-specific shape. In juveniles from Sierra Nevada and Sierra de Cazorla a lateral knob in the proximal penis is lacking while in the adult specimens it is always present. The same phenomenon can be observed among young individuals of *D. nitidum* collected in Serra de Caldeirão and Serra de Monchique.

Collected topotypes of *D. hilbrandi* are similar to those of *D. nitidum* from Serra de Monchique, the only differences being the darker colour of *D. hilbrandi* and the smaller size of the penial gland in *D. nitidum*, but these features are taxonomically unimportant.

Altena, after comparing *D. hilbrandi* with *D. nitidum*, thought that he was dealing with two different species as *D. nitidum* lacked a short rectal caecum, observable in *D. hilbrandi*, and in the latter, in contrast to *D. nitidum*, a lateral knob in the proximal penis was absent. Nevertheless, we have found no rectal caecum in the 43 dissected specimens from the type locality of *D. hilbrandi*. Furthermore, a rectal caecum is also absent in the paratype of *D. hilbrandi* we have examined. The specimen is externally black, with a large tongue-shaped stimulator, ovotestis (which does not reach the rear end of the visceral mass) not very dark, and without a lateral knob in its proximal penis, the latter features clearly indicating the juvenile condition of Altena's paratype.

In this regard, the explanation for what some authors have called "traces of a short rectal caecum" may be that the rectum has a greater diameter and consists of more

flexible material than the intestine, and depending on the variable degree of relaxation of the musculature, the proximal segment of the rectum may protrude above the adjoining intestine. On such occasions a small sac is visible in that region, thus giving the impression of a rectal caecum; as we could see, this was the case with *D. hilbrandi.*

In conclusion, because of their similar anatomy and external appearance we propose to consider *Deroceras hilbrandi* Altena, 1964, a junior synonym of *Deroceras nitidum* (Morelet, 1845).

Deroceras altimirai Altena, 1969, figs. 9-16, 52

Material examined: Linsoles reservoir, UTM 31TBH91 (Benasque), Huesca, Aragon), 09.11.89, 9 specimens. Vallibierna valley, UTM 31TBH92 (Benasque), 10.11.89, 4 specimens. Capsacostas pass, UTM 31TDG57 (Olot, Girona, Catalonia), 13.11.89, 13 specimens. Nostra Senyora de la Salut's Sanctuary, UTM 31TDG56 (Hostalets d'En Bas, Girona), 13.11.89, 9 specimens. Sallent, UTM 31TDG03 (Manresa, Barcelona, Catalonia), 14.11.89, 7 specimens. Balsareny, UTM 31TDG03 (Manresa), 14.11.89, 6 specimens.

We have examined 48 specimens of *D. altimirai* and it is only in one feature that they differ from Altena's (1969) original description and De Winter's remarks. While both authors reported a single penial appendix, all the specimens studied by us showed two appendices of unequal size. The average length of live specimens is 45 mm and their colour dark grey with or without black spots. Preserved specimens (figs. 9, 10) measure on average 38 mm and their backs always become black speckled. Body mucus is white, but less milky than in *D. reticulatum* (Müller, 1774). The ovotestis does not extend to the rear end of the visceral mass and the rectum has a short caecum (fig. 12).

The genital system (figs. 11, 13), as has been stated above, differs a little from the original description of the species. The proximal penis has two appendices, instead of only one, which are mamillate, unequally sized and situated on both sides of the retractor muscle insertion. The lower part of the penis has a spherical knob of glandulous walls. The sarcobelum is within the distal penis (figs. 14-16) and its shape is conical, with a somewhat blunt apex.

Deroceras tarracense Altena, 1969, figs. 17-22, 52

Material examined: Coll d'Alforja, UTM 31TCF26 (Serra del Montsant, Tarragona, Catalonia), 15.11.89, 15 specimens. Port de Albarca, UTM 31TCF36 (Serra del Montsant), 15.11.89, 17 specimens.

The anatomy of our topotypes accords well with Altena's (1969) description of *D. tarracense.* The specimens collected by us measured, when alive, 40 mm, shrinking a little when preserved in 70% ethanol (figs. 17, 18). The dorsum is brown, more or less dark-tinged, with blackish speckles. Preserved specimens get more intensely speckled than when alive. The body mucus is colourless. The rectum is provided with a short to very short, lateral caecum, which is always present (fig. 20). The thin connective tissue surrounding the visceral mass lacks pigmentation. The ovotestis does not attain the rear end of the visceral mass and is clearly visible on its surface (fig. 20). The ovotestis, hermaphrodite duct, albumen gland and spermoviduct are typical for the genus

Deroceras. The spermatheca is oval-shaped and has a short duct. The penis is small (figs. 21, 22) and divided into two parts, but without a mid-constriction. In the proximal part there is a small mamillate appendix, with smooth, even surface. The penial retractor muscle is strong and attaches to the penis terminally near the site where the vas deferens enters the penis. The distal penis has a very long, pointed appendix provided with transversal fissures that give the appearance of lobulation, and a longitudinal fissure, which indicates the direction of an inner thick fold. The inner surface of the penial wall is lined with fine irregular folds and grooves, fingerprint-like. The only sarcobelum-like structure to be found inside the penis is a thick fold within the distal appendix (fig. 19); perhaps this appendix is everted during copulation as a stimulatory organ.

Deroceras tarracense was considered by De Winter (1986) as a subspecies of *D. altimirai, D. altimirai tarracense*. We do not agree with this change, since we think the anatomical differences between the two forms are important enough to keep them mutually isolated. Although in both forms the ovotestis does not reach the rear end of the visceral mass and there exists a rectal caecum, the penial structures are basically different. Thus, *D. altimirai* has two appendices in the proximal penis whilst *D. tarracense* has only one; the stimulatory organ in *D. altimirai* is tongue-shaped or conical and is situated in the distal penis, but there is no such an organ within the distal penis of *D. tarracense*. Finally, in *D. altimirai* the external surface of the distal penis (which has an ovoid appendix) is provided with a cap of glandulous epithelium, absent from the distal penis (which has a triangular appendix) of *D. tarracense*.

Deroceras levisarcobelum De Winter, 1986, figs. 23-32, 52

(= *Deroceras altimirai levisarcobelum* De Winter, 1986)

Material examined: Pont de Bar, UTM 31TCG79 (Seu d'Urgell, Lleida, Catalonia), 12.11.89, 27 specimens. Setcases, UTM 31TDG49 (Camprodon, Girona, Catalonia), 12.11.89, 4 specimens. Pullosa pass, UTM 31TDG34 (Collsupina, Vich, Barcelona, Catalonia), 14.11.89, 13 specimens. Holotype and paratype: Department of Ariège, near Aigues-Juntes, along the D_1 (15 km NW of Foix), UTM CH86, deposited in the Nationaal Natuurhistorisch Museum of Leiden (The Netherlands). De Winter leg.

Having discovered a new form of slug in the French Pyrenees, De Winter (1986) described it as *Deroceras altimirai levisarcobelum*, considering it to be conspecific with *D. altimirai* and *D. terracense* Altena, 1969, which thus became respectively *D. a. altimirai* and *D. a. tarracense*. De Winter based his proposal of taxonomic change on the similarity observed in the penial apices of the three forms, on the fact that these three forms inhabited contiguous areas, and on the discovery of intermediate specimens between typical *D. altimirai* and his new form.

The subspecific epithet of *D. altimirai levisarcobelum* refers to the smooth surface of its sarcobelum, which lacks the usual furrows present in other *Deroceras* forms. This slug is reported to have an ovotestis extending to the rear end of the visceral mass and a very short, if not completely absent, rectal caecum. The original description asserts that the penis has on its upper part an appendix and on its lower part a conspicuous knob, being the division of the penis into an upper and a lower part very indistinct externally.

In the course of our research work in the Spanish Pyrenees we have collected many specimens which, although differing in a few details from *D. levisarcobelum*, can be

assigned to that taxon on the basis of the structure of the penial complex. Live specimens measure on average 50 mm and are dark brown, some nearly black. When preserved in 70% ethanol, they become light brown and speckled with black spots and shrink until they are 30-35 mm in length (figs. 23, 24). In contrast to De Winter's description, the ovotestis does not extend to the rear end of the visceral mass (fig. 25) and in all cases the rectum shows a short caecum that is completely developed even in juveniles. In adults the penis is a short, pear-shaped and plump structure, with a finger-like appendix on its upper part. Neither a spherical knob, nor a glandulous area do exist in the lower part of the penis. The division of the penis into two sections cannot be observed. Young specimens have a cylindrical, thin-walled penis (fig. 30), from which a hook-like appendix hangs. The area where the vas deferens enters the penis is covered with black pigment in juveniles.

The inner surface of the penis is lined with folds (figs. 27-29) that are less marked in juveniles than in adults (figs. 28, 29). These folds are in turn supplied with longitudinal and radial grooves that altogether resemble the "fingerprint-like pattern" in De Winter's description. However, this pattern has no constant configuration and its extension and shape vary from individual to individual. These folds may perhaps be everted during copulation, thus acting as a sarcobelum, which is absent in our specimens.

As reference material two paratypes from the French Pyrenees, kindly supplied by the Nationaal Natuurhistorisch Museum of Leiden, were studied. These specimens had been collected in the Département of Ariège, 15 km NW. of Foix, and their characters accord well with De Winter's description. Some differences can be observed between these paratypes and our specimens. In the paratypes there is no rectal caecum (here the point must be stressed that, if we are to accept the traditional subgeneric division of *Deroceras*, based among other characters on the presence/absence of a rectal caecum, we would have to classify the two compared forms in different subgenera, what seems by no means appropriate), the ovotestis attains the rear end of the visceral mass, and the sarcobelum is represented by an ill-defined smooth knob. Since in both our specimens and the paratypes a glandulous receptaculum in the distal penis is absent, perhaps the sarcobelum of *D. levisarcobelum* should be best considered as vestigial or non-existing.

Noticing the remarkable anatomical differences existing between *D. altimirai, D. tarracense* and *D. levisarcobelum* (above all, the different structures of penes and sarcobela, which we consider of greatest importance in keeping species separate), and the relative scarcity of the material studied up to now, we think it more proper to consider these forms to represent species and await new findings either to confirm or contradict this argument.

Deroceras ercinae De Winter, 1985, figs. 33-41, 52

Material examined: Monastery of Covadonga, UTM 30TUN39 (Cangas de Onís, Asturias), 17.11.88, 9 specimens.

Specimens studied measure c. 29 mm when preserved in alcohol (figs. 33, 34). Body colour ranges from light to dark hues of brown. In live specimens, as well as in spirit material, the dorsum has small dark spots. The ovotestis reaches the rear end of the visceral mass (fig. 35). The rectum lacks a caecum (fig. 35). The penis (figs. 36, 40, 41) is divided into two sections. The proximal part shows a festooned appendix and, on the

opposite, a spherical diverticulum. The distal penis is bulbous, bulky, with glandulous walls. The conical sarcobelum (figs. 37, 38) lodges within the distal penis.

In the vicinity of the Monastery of Covadonga, on 17 March 1988 by night, we were able to take photographs of an ongoing copulation of *D. ercinae*. The complete courtship behaviour is unknown to us since the copulation was already in progress at the time of discovery. The pair were encountered facing each other, bending in a C shape, with the anterior part of their right sides in contact. The tips of the sarcobela protruded and were touching the partner's side; then the remainder of the penis was everted and the sarcobelum played over the partner's head. After a time, the slugs began to withdraw their genitalia, so that only the cone-shaped apices of sarcobela remained visible. Both specimens turned aside describing a semicircle, one to its right and the other to its left, until their left sides came into contact. The pair subsequently returned to its initial position and, after curving their bodies, the partners closely approached each other. Then, with the penis almost completely everted, they raised the anterior third of the body and coiled round one another in a spiral, thus resembling a corkscrew. In this process the sole of the anterior third of body came to lie on the partner's back. Now the individuals slowly followed one another in a clockwise circular movement and the genitalia appeared as a translucent, hyaline mass covered in a somewhat watery mucous exudation. It is at this moment that sperm exchange takes place. Then the genitalia began to shrink and the pair disentangled and finally moved away. On the dead oak-leaf where coitus was performed the animals left a thin sheet of transparent mucus.

At first sight *D. ercinae* could easily be mistaken for *D. nitidum*. Nevertheless, it is possible to tell one from the other by paying attention to the following features. In *D. nitidum* the ovotestis does not reach the rear end of the visceral mass, in contrast to the condition in *D. ercinae*; in *D. nitidum* the branches of the penial appendix are longer and appear in larger numbers than in *D. ercinae*. Furthermore, both species differ in some details of copulation. In *D. nitidum* the penial gland is everted and placed over the partner's back (Castillejo et al., 1989), while in the coitus of *D. ercinae* this does not occur. Different is also the disposition of partners during the copulation: closely fitted into one another in *D. nitidum* and spirally coiled in *D. ercinae*.

Deroceras vascoana De Winter, 1986, fig. 52

Material examined: Alto de Lizarrusti, UTM 30TWN75 (Navarra), 07.11.89, 2 specimens. Two paratypes from "Spain, Navarra, near Alto de Lizarrusti (= 13 km SSE of Beasain); 650 m alt., IV.1985. UTM WN75 [sic]".

We could collect only two young specimens of *D. vascoana* on the surface of leaf-litter of the beechwood of Alto de Lizarrusti and their external and internal morphology is identical to that of De Winter's paratypes. These juveniles were light brown in the field. The ovotestis does not reach the rear end of the visceral mass. The rectum lacks a caecum although a lateral sac is visible in the usual area, owing to the different diameters of rectum and intestine. The penis shows the same structure and pigmentation as those indicated by De Winter. The penial gland is profusely branched. Inside the lower part of the penis lodges the sarcobelum which, although conical in shape, is somewhat different from that of *D. reticulatum* (not so large and pointed).

Since this form could possibly be a mere variety of *D. rodnae, D. ercinae,* or *D. nitidum*, a thorough study of *D. vascoana* in different habitats and seasons of the year is required to ascertain its specific variability.

Deroceras rodnae Grossu & Lupu, 1965, figs. 42-52

Material examined: Setcases, UTM 31TDG49 (Camprodon, Girona, Catalonia), 12.11.89, 5 specimens. Capsacostas pass, UTM 31TDG57 (Olot, Girona), 13.11.89, 6 specimens.

Deroceras rodnae was recorded from the Iberian Peninsula by Castillejo & Manga-González (1986) for the first time. The specimens collected in the province of Girona measure 30-40 mm in length but when preserved they do not surpass 35 mm (figs. 42, 43). The body colour is uniformly brown, with no traces of spots. The body mucus is milky white, more water-like than that of *D. reticulatum*. The ovotestis does not extend to the rear end of the visceral mass (figs. 44, 51). The penis is divided into two parts (fig. 45, 47, 50). The proximal or upper part has a long penial appendix, with only one festooned margin. The distal or lower part of the penis contains a flabelliform sarcobelum (figs. 46, 49) which, when at rest, remains folded up, looking like a cone.

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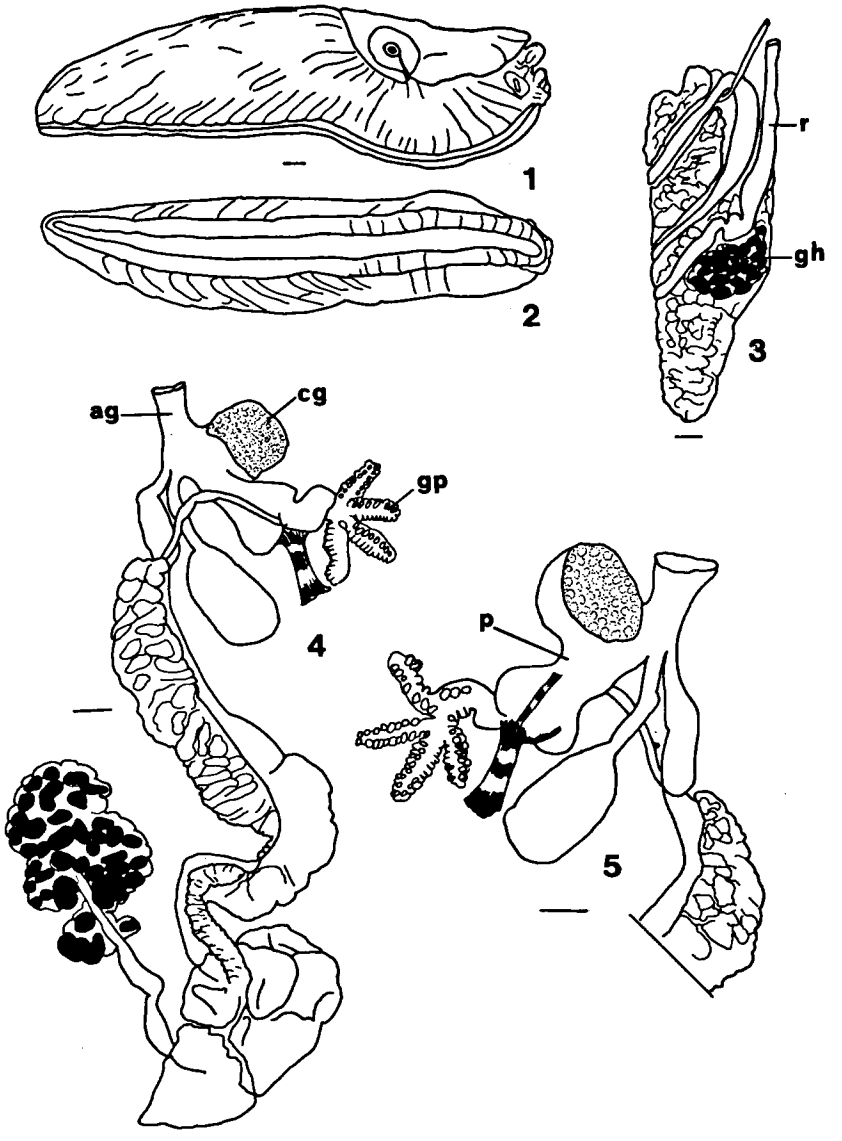
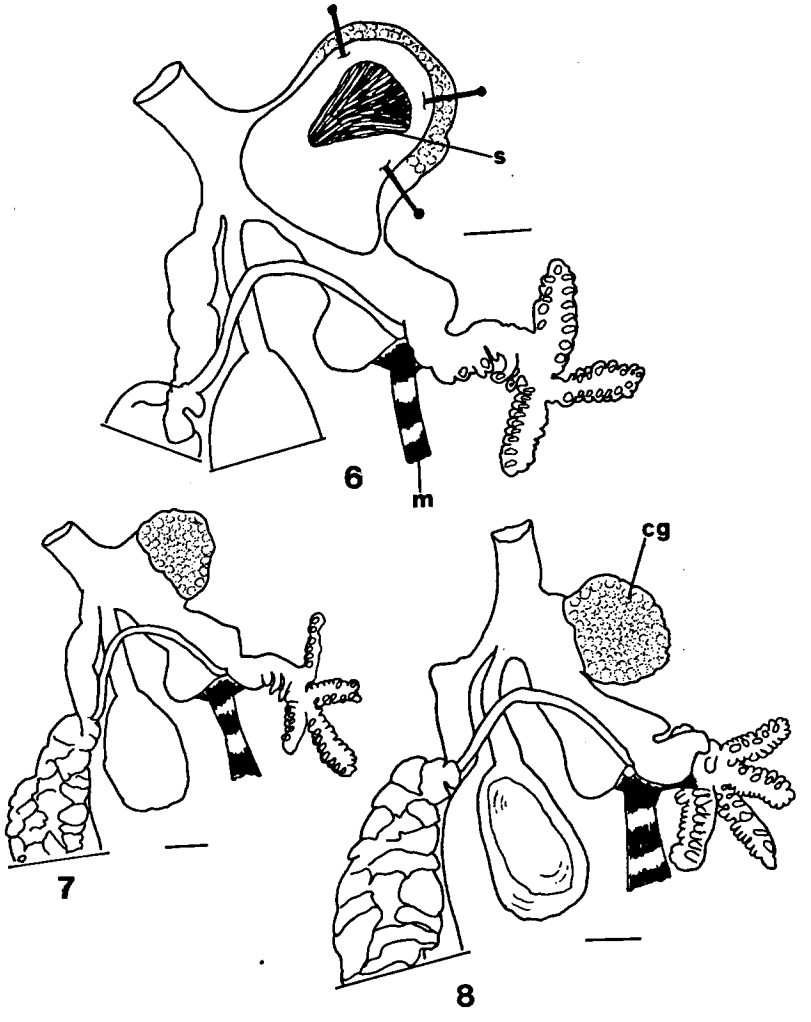
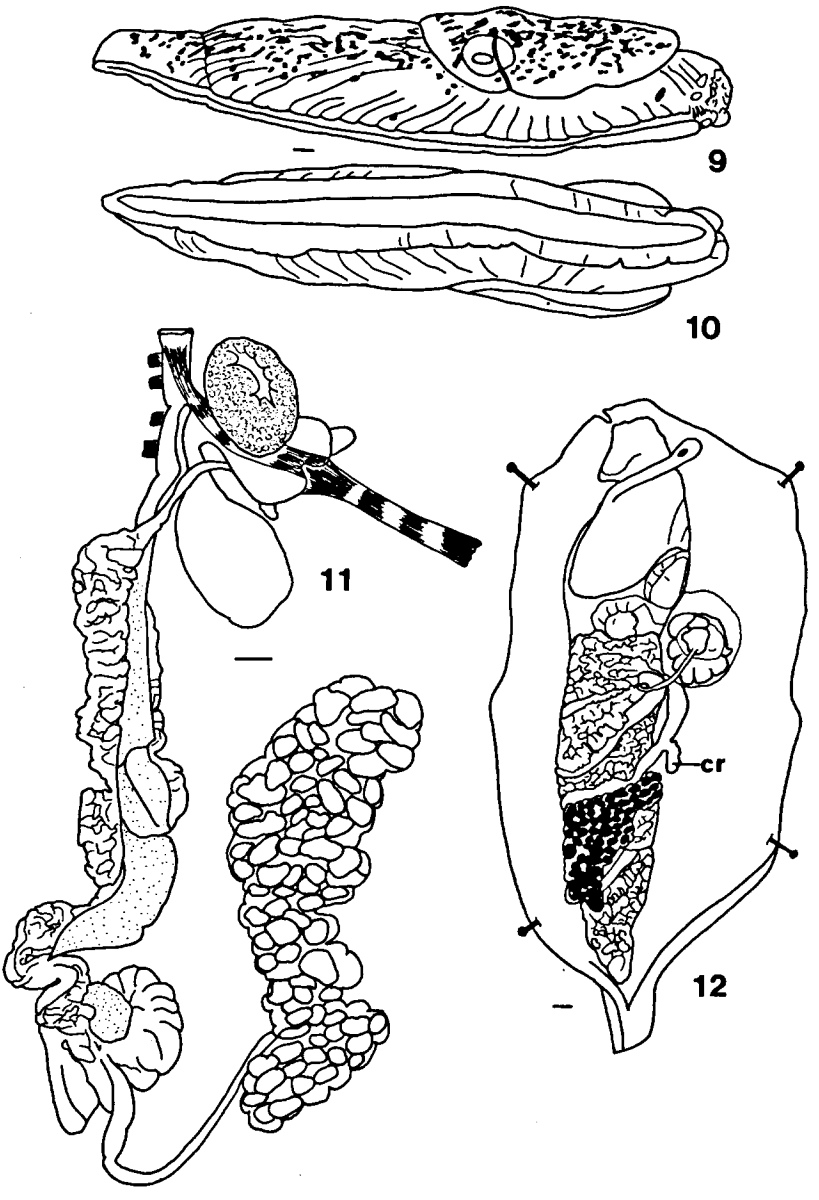


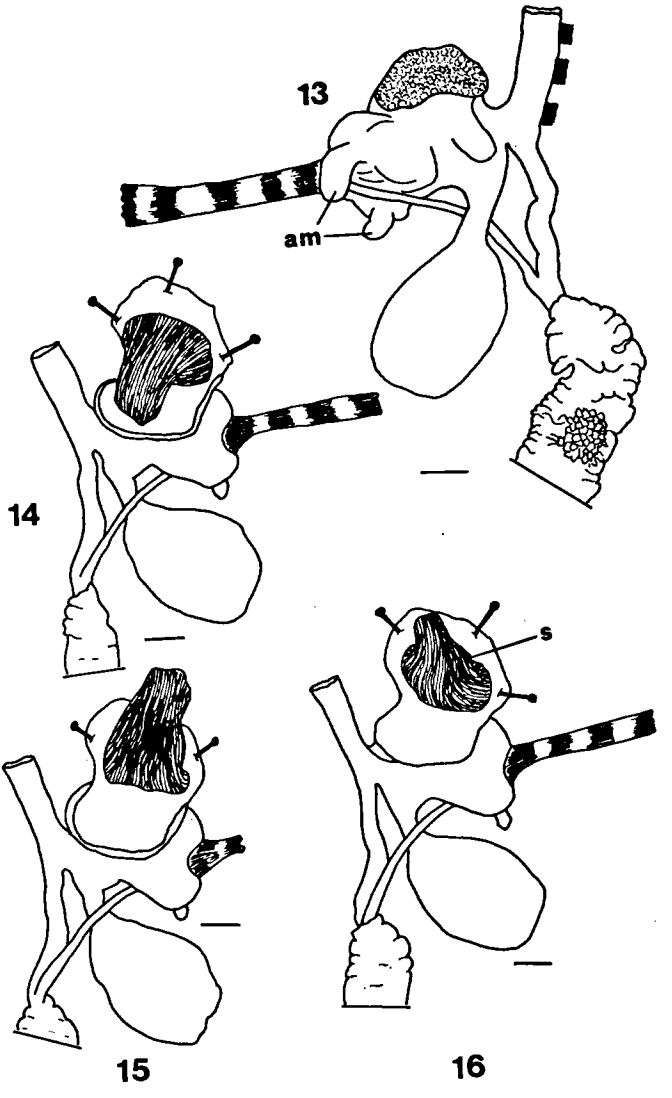
Figs. 1-5. *Deroceras nitidum*. Sierra Nevada (Granada). 1-2, external morphology, lateral and ventral views; 3, end of visceral mass, ovotestis and rectum; 4-5, genital system. Scale bars 1 mm; ag: genital atrium, cg: glandulous cap, gh: ovotestis, gp: penial gland, p: penis, r: rectum.



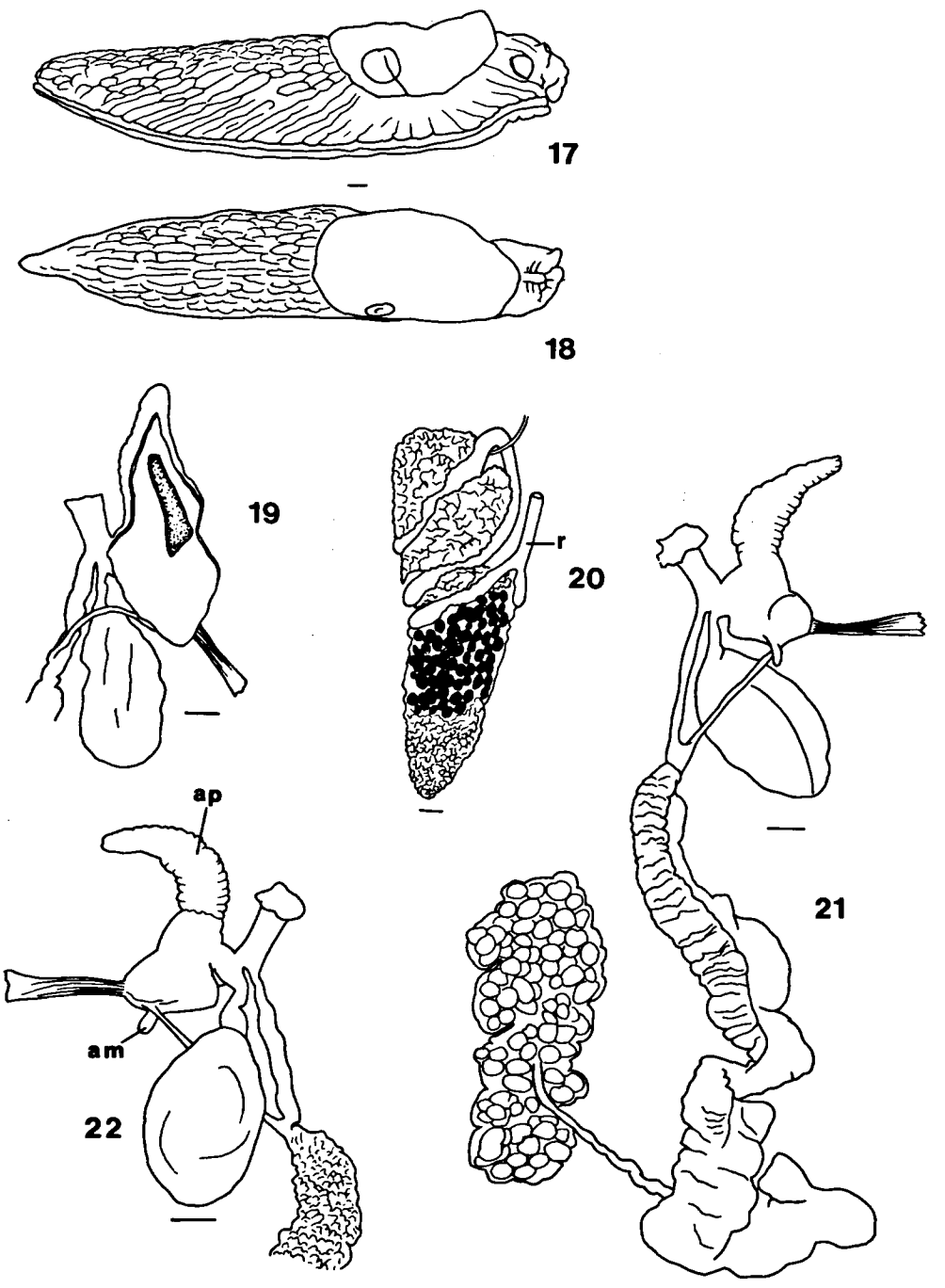
Figs. 6-8. *Deroceras nitidum.* Sierra Nevada (Granada). 6, sarcobelum inside distal penis; 7-8, genital system. Scale bars 1 mm; cg: glandulous cap, m: penial rectractor muscle, s: sarcobelum (= stimulatory organ).



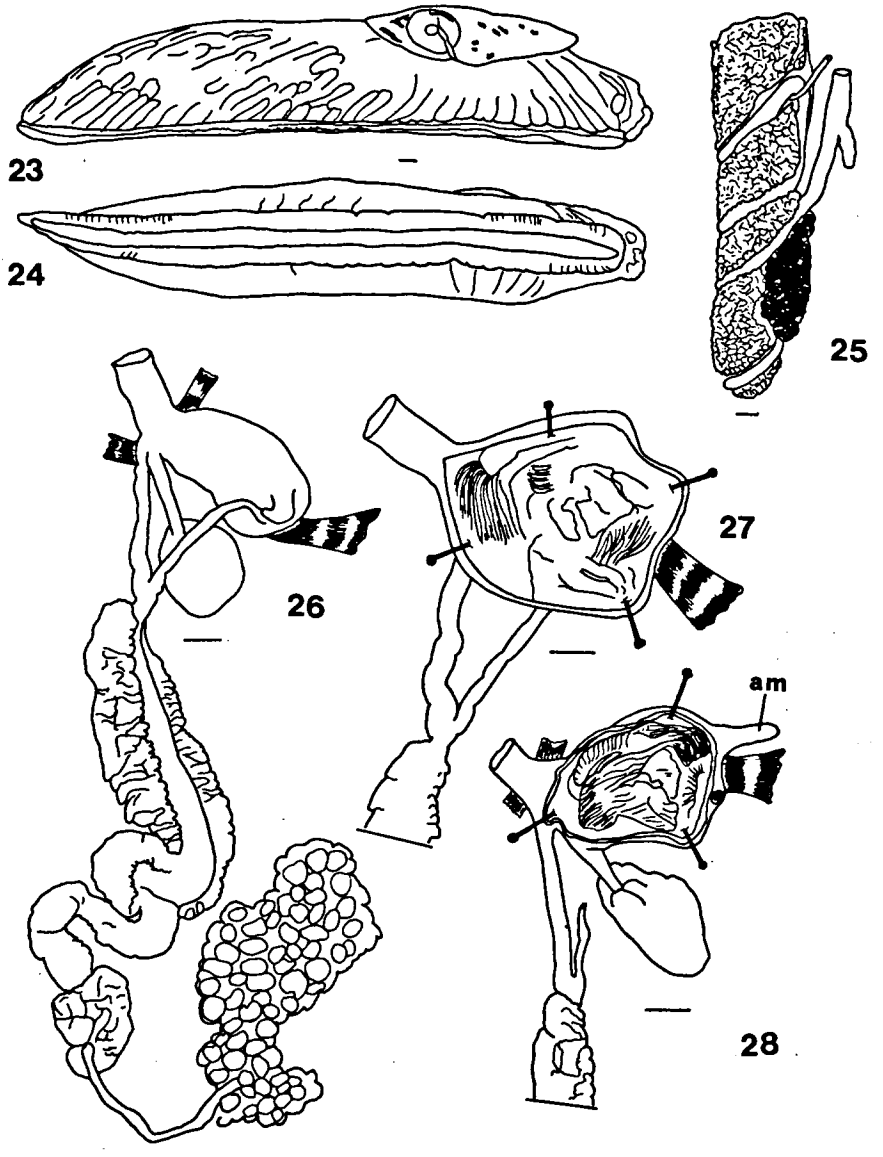
Figs. 9-12. *Deroceras altimirai*. Capsacostas (Olot). 9-10, external morphology, side and ventral views; 11, genital system; 12, internal morphology, organs in situ. Scale bars 1 mm; cr: rectal caecum.



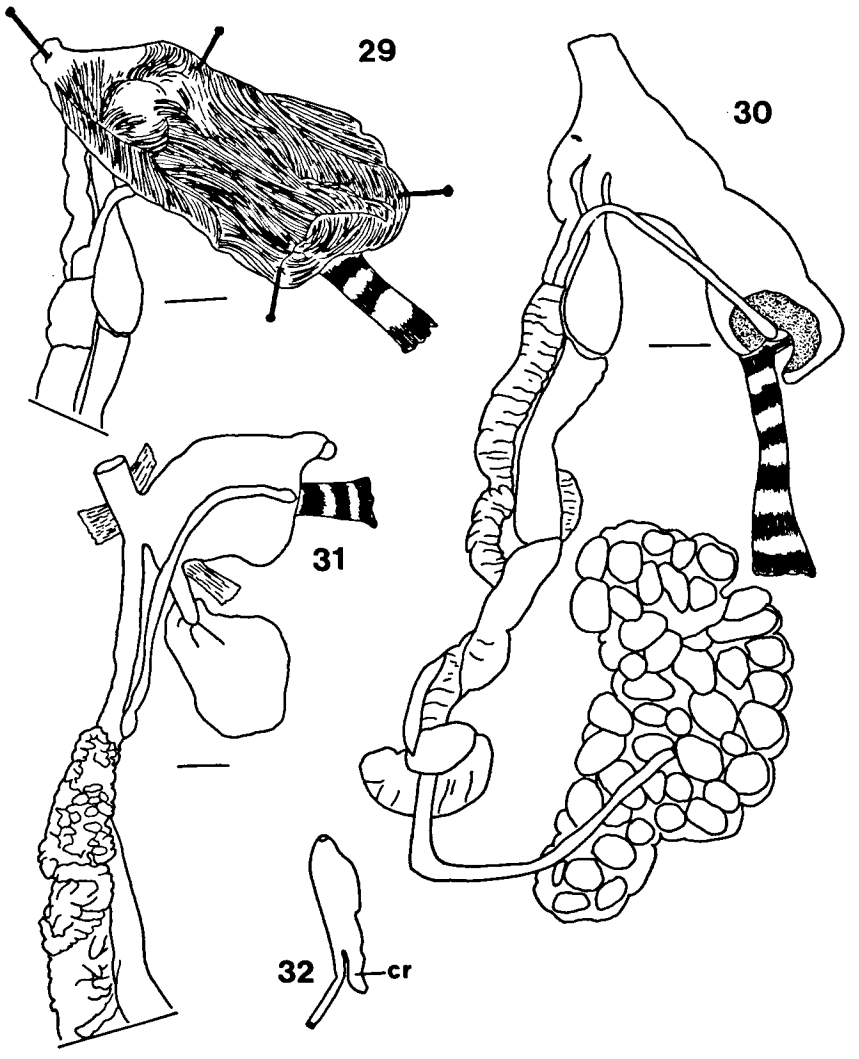
Figs. 13-16. *Deroceras altimirai.* Capsacostas (Olot). 13, genital system, proximal penis with two appendices; 14-16, sarcobelum inside distal penis. Scale bars 1 mm; am: mamilla appendix, s: sarcobelum.



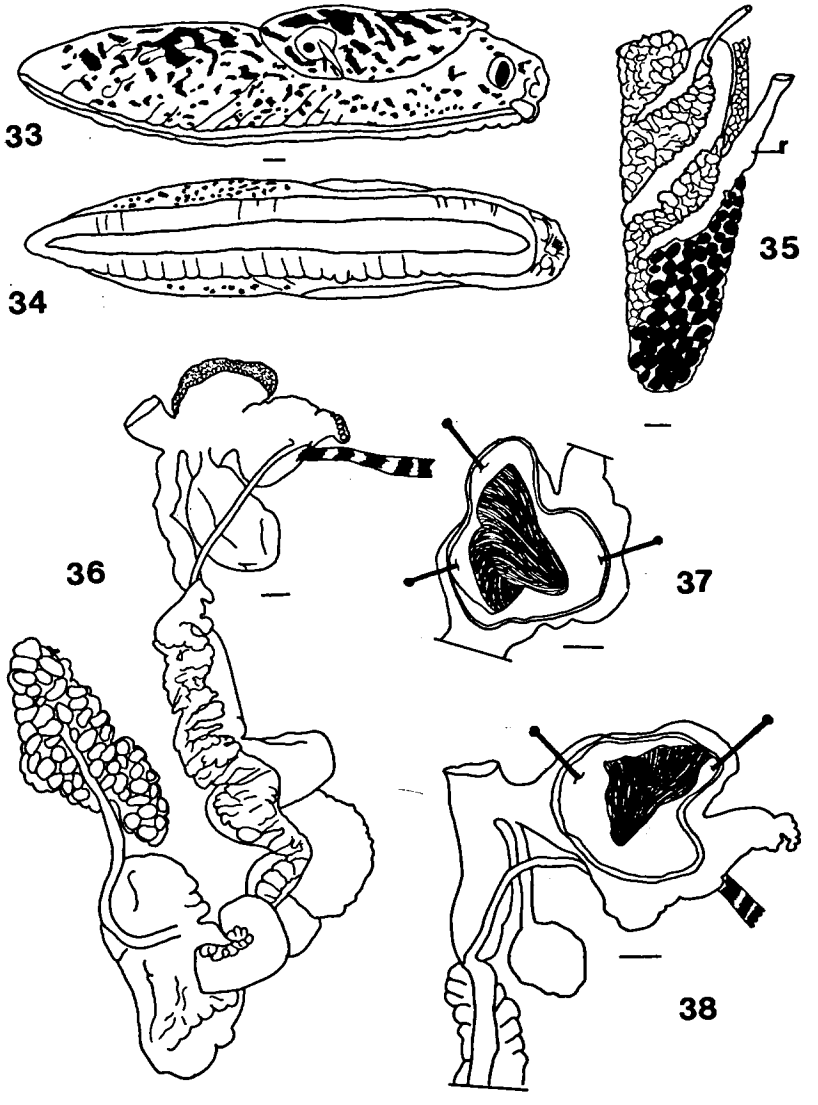
Figs. 17-22. *Deroceras tarracense*. Serra de Montsant (Tarragona). 17-18, external morphology; side and dorsal views; 19, thick fold inside distal penis; 20, end of visceral mass; 21, genital system; 22, copulatory organs seen from the other side. Scale bars 1 mm; am: mamilla appendix, ap: appendix, r: rectum.



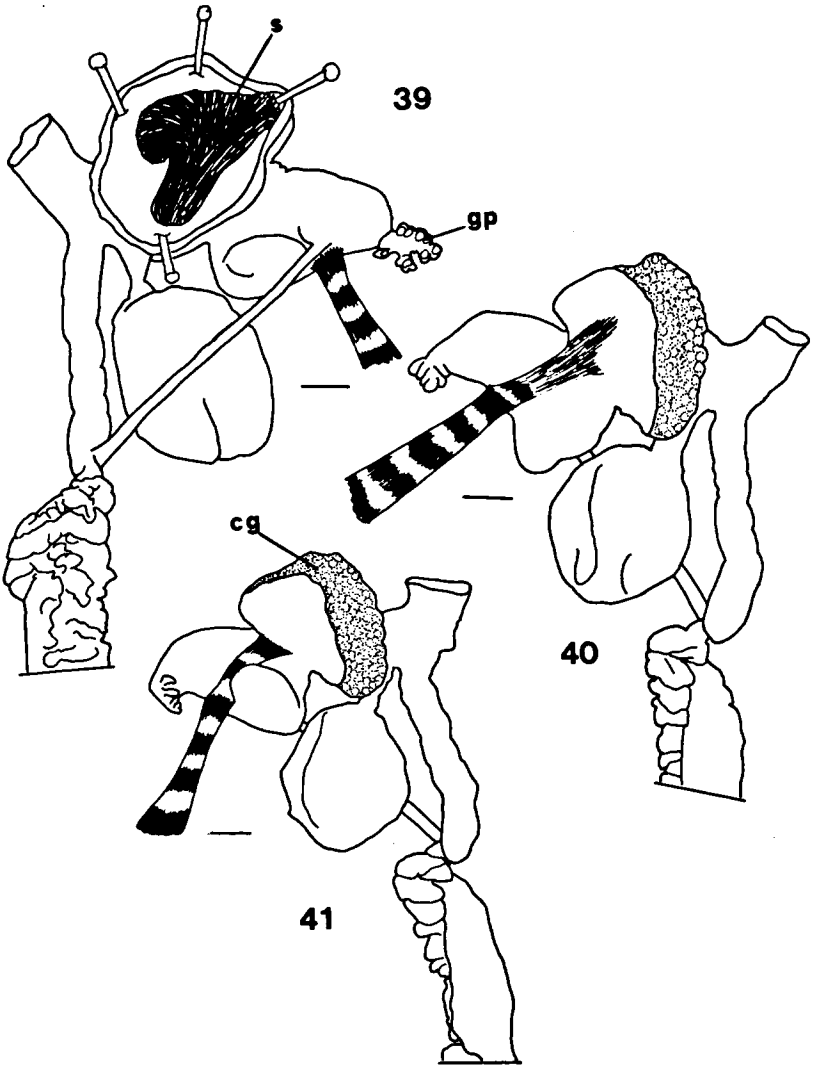
Figs. 23-28. *Deroceras levisarcobelum*. Pont de Bar (Seu d'Urgell). 23-24, external morphology; side and ventral views; 25, end of visceral mass, ovotestis, rectal caecum; 26, genital system from subadult specimen; 27, sarcobelum in the penis of the same subadult specimen; 28, sarcobelum from genital system in fig. 31 (adult specimen). Scale bars 1 mm; am: mamilla appendix.



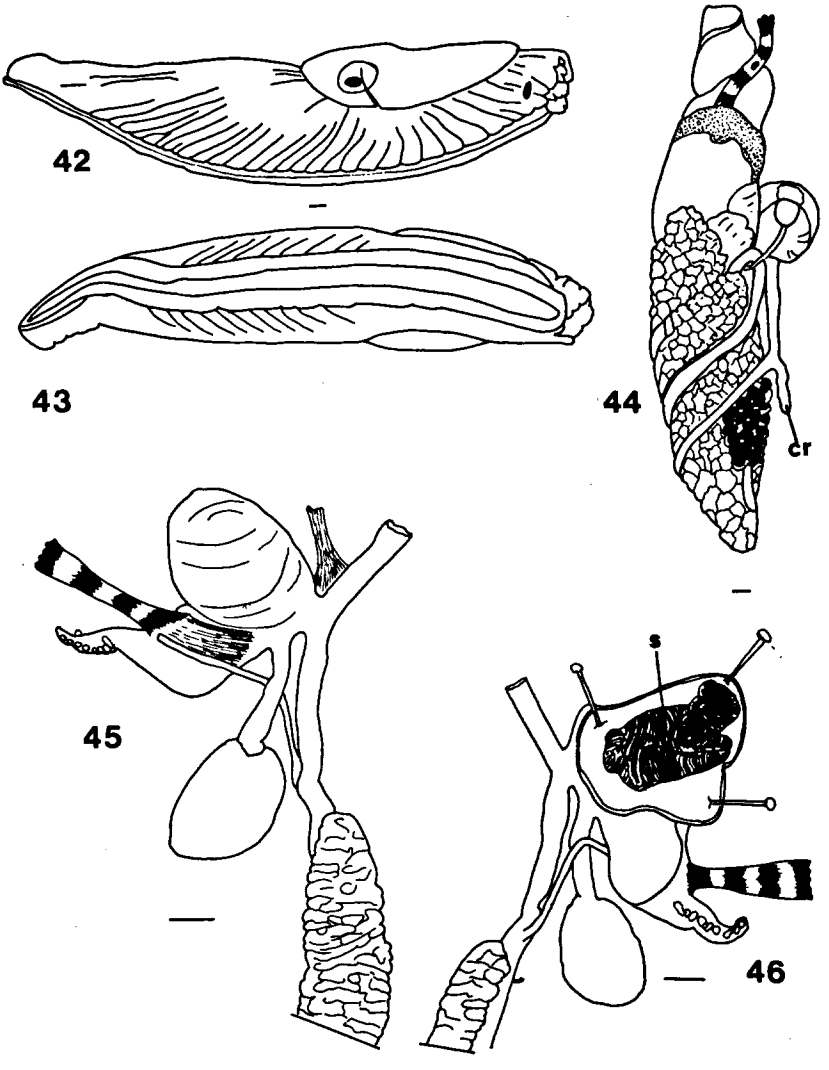
Figs. 29-32. *Deroceras levisarcobelum*. 29-30, genital system and sarcobelum of a young specimen collected in Setcases (Camprodon); 31, genital system of an adult specimen from Pont de Bar; 32, rectal caecum (cr). Scale bars 1 mm.



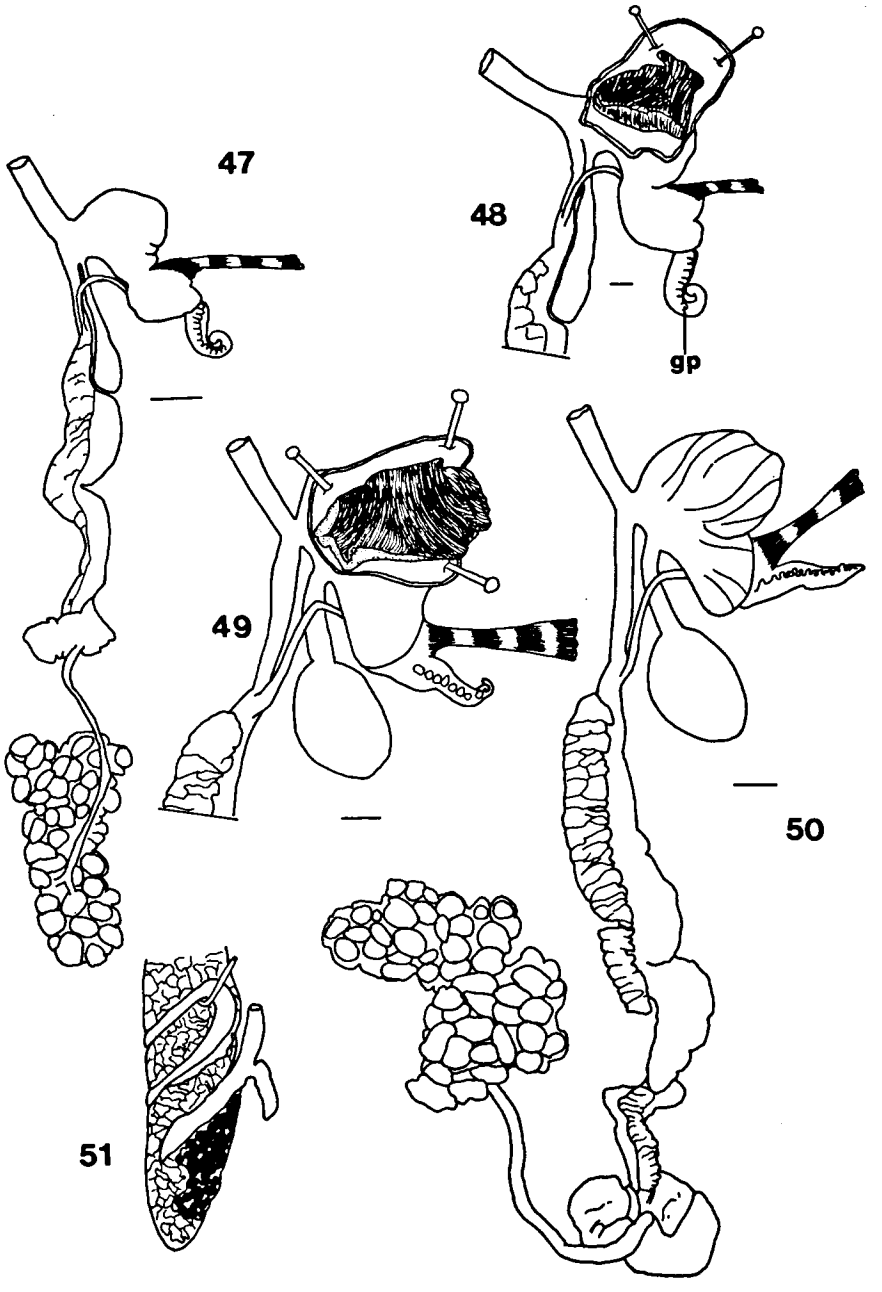
Figs. 33-38. *Deroceras ercinae.* Covadonga Monastery (Asturias). 33-34; external morphology, side and ventral views; 35, end of visceral mass, with ovotestis and rectum; 36, genital system; 37-38, sarcobelum inside penis. Scale bars 1 mm; r: rectum.



Figs. 39-41. *Deroceras ercinae*. Covadonga Monastery (Asturias). 39, sarcobelum; 40-41, several views of penis. Scale bars 1 mm; cg: glandulous cap, gp: penial gland, s: sarcobelum.



Figs. 42-46. *Deroceras rodnae.* Capsacostas (Olot). 42-43, external morphology, side and ventral views; 44, internal morphology, organs in situ; 45, anterior region of the genital system; 46, sarcobelum inside penis. Scale bars 1 mm; cr: rectal caecum, s: sarcobelum.



Figs. 47-51. *Deroceras rodnae*. Capsacostas (Olot). 47-50, genital system; 48-49, flabelliform sarcobelum; 51, end of visceral mass. Scale bars 1 mm; gp: penial gland.

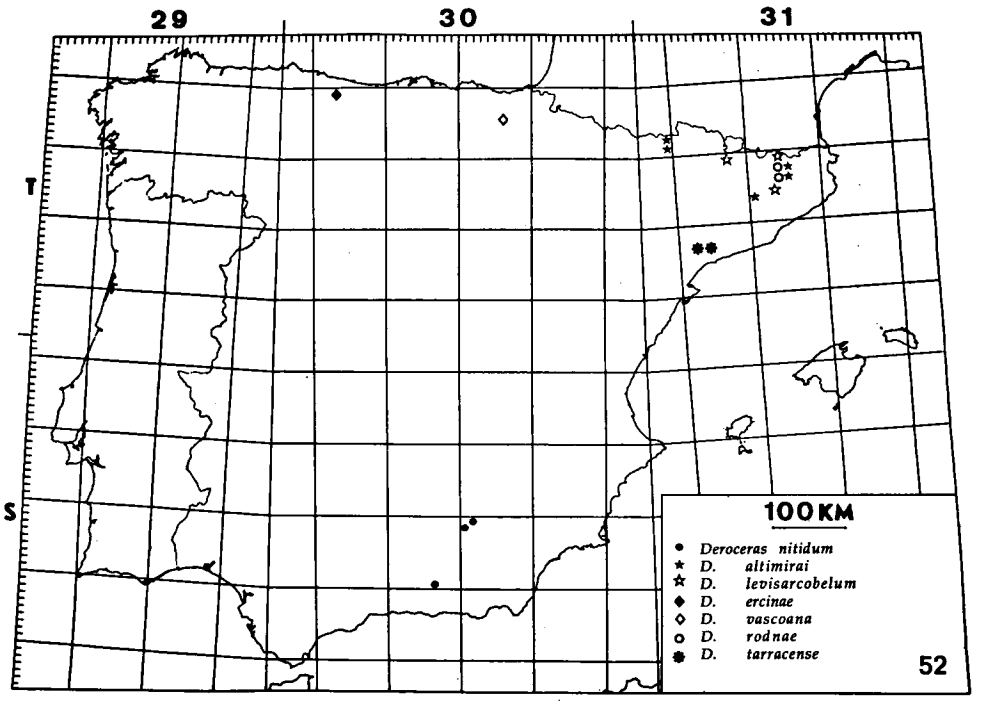


Fig. 52. Distribution records of various species of *Deroceras* in Spain.